DOCUMENT RESUME

ED 190 892 CE 026 577

TITLE	Military Curricula for Vocational & Technical Education. Curriculum Outline for Basic Electricity and Electronics Modules 15-25. CANTRAC A-100-0010. Revised Edition.
INSTITUTION	Chief of Naval Education and Training Support, Pensacola, Fla.: Ohio State Univ., Columbus. National Center for Research in Vocational Education.
REPORT NO	CNTT-E-028
PUB DATE	May 79
NOTE	73p.; For related documents see CE 026 560-593.
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	Course Objectives; Curriculum Guides; *Electricity; *Electronics; Individualized Instruction; Learning Modules; Postsecondary Education; Programed Instruction; Student Educational Objectives; *Technical Education
IDENTIFIERS	Military Curriculum Project

ABSTRACT

This curriculum outline is a compilation of student learning objectives for modules 15-25 of the military-developed basic electricity and electronics course. The course is one of a number of military-developed curriculum packages selected for adaptation to vocational instructional and curriculum development in civilian settings. For each module, the outline provides student objectives for the module and for each lesson within the module. (LRA)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED190892

CNTT E-028

CHIEF OF NAVAL EDUCATION AND TRAINING

MAY 1979

Military Curricula for Vocational & Technical Education

CURRICULUM OUTLINE FOR BASIC ELECTRICITY AND ELECTRONICS MODULES 15 - 25.

REVISED MAY 1979.

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

CE 026 577

THE NATIONAL CENTER FOR RESEARCH IN VOCATIONAL EDUCATION
THE OHIO STATE UNIVERSITY

MILITARY CURRICULUM MATERIALS

The military-developed curriculum materials in this course package were selected by the National Center for Research in Vocational Education Military Curriculum Project for dissemination to the six regional Curriculum Coordination Centers and other instructional materials agencies. The purpose of disseminating these courses was to make curriculum materials developed by the military more accessible to vocational educators in the civilian setting.

The course materials were acquired, evaluated by project staff and practitioners in the field, and prepared for dissemination. Materials which were specific to the military were deleted, copyrighted materials were either omitted or approval for their use was obtained. These course packages contain curriculum resource materials which can be adapted to support vocational instruction and curriculum development.

Military Curriculum Materials Dissemination Is . . .

an activity to increase the accessibility of military-developed curriculum materials to vocational and technical educators.

This project, funded by the U.S. Office of Education, includes the identification and acquisition of curriculum materials in print form from the Coast Guard, Air Force, Army, Marine Corps and Navy.

Access to military curriculum materials is provided through a "Joint Memorandum of Understanding" between the U.S. Office of Education and the Department of Defense.

The acquired materials are reviewed by staff and subject matter specialists, and courses deemed applicable to vocational and technical education are selected for dissemination.

The National Center for Research in Vocational Education is the U.S. Office of Education's designated representative to acquire the materials and conduct the project activities.

Project Staff:

Wesley E. Budke, Ph.D., Director
National Center Clearinghouse

Shirley A. Chase, Ph.D.
Project Director

What Materials Are Available?

One hundred twenty courses on microfiche (thirteen in paper form) and descriptions of each have been provided to the vocational Curriculum Coordination Centers and other instructional materials agencies for dissemination.

Course materials include programmed instruction, curriculum outlines, instructor guides, student workbooks and technical manuals.

The 120 courses represent the following sixteen vocational subject areas:

- Agriculture
- Aviation
- Building & Construction Trades
- Clerical Occupations
- Communications
- Drafting
- Electronics
- Engine Mechanics
- Food Service
- Health
- Heating & Air Conditioning
- Machine Shop
- Management & Supervision
- Meteorology & Navigation
- Photography
- Public Service

The number of courses and the subject areas represented will expand as additional materials with application to vocational and technical education are identified and selected for dissemination.

How Can These Materials Be Obtained?

Contact the Curriculum Coordination Center in your region for information on obtaining materials (e.g., availability and cost). They will respond to your request directly or refer you to an instructional materials agency closer to you.

CURRICULUM COORDINATION CENTERS

EAST CENTRAL
Rebecca S. Douglass
Director
100 North First Street
Springfield, IL 62777
217/782-0759

NORTHWEST
William Daniels
Director
Building 17
Airdustrial Park
Olympia, WA 98504
206/753-0879

MIDWEST
Robert Patton
Director
1515 West Sixth Ave.
Stillwater, OK 74704
405/377-2000

SOUTHEAST
James F. Shill, Ph.D.
Director
Mississippi State University
Drawer DX
Mississippi State, MS 39762
601/325-2510

NORTHEAST
Joseph F. Kelly, Ph.D.
Director
225 West State Street
Trenton, NJ 08625
609/292-6562

WESTERN
Lawrence F. H. Zane, Ph.D.
Director
1776 University Ave.
Honolulu, HI 96822
808/948-7834

The National Center Mission Statement

The National Center for Research in Vocational Education's mission is to increase the ability of diverse agencies, institutions, and organizations to solve educational problems relating to individual career planning, preparation, and progression. The National Center fulfills its mission by:

- Generating knowledge through research
- Developing educational programs and products
- Evaluating individual program needs and outcomes
- Installing educational programs and products
- Operating information systems and services
- Conducting leadership development and training programs

FOR FURTHER INFORMATION ABOUT
Military Curriculum Materials
WRITE OR CALL

Program Information Office
The National Center for Research in Vocational Education
The Ohio State University
1960 Kenny Road, Columbus, Ohio 43210
Telephone: 614/486-3655 or Toll Free 800/848-4815 within the continental U.S. (except Ohio)

THE NATIONAL CENTER FOR RESEARCH IN VOCATIONAL EDUCATION
The Ohio State University · 1960 Kenny Road · Columbus, Ohio 43210
Tel. (614) 486-3655 Cable: CTVOCEDOSU/Columbus, Ohio

Military Curriculum Materials for Vocational and Technical Education

Information and Field Services Division

The National Center for Research in Vocational Education

COURSE DATA PAGE

1. COURSE MISSION:

To train personnel who are ordered to specific A-1 schools to demonstrate the applied skills and knowledge of basic electricity and electronics that have been designated by each of the schools to be entry-level prerequisites.

2. COURSE LENGTH:

108 contact hours; 4 weeks, average

3. LOCATIONS AT WHICH TAUGHT:

Service School Command, San Diego, California

Service School Command, Great Lakes, Illinois

Service School Command, Orlando, Florida

4. CLASS CAPACITY:

Normal Load: 18 per carrel group

Maximum Load: 30 per carrel group

5. INSTRUCTOR REQUIREMENTS:

18 per shift, 36 total for BE&E San Diego

6. INSTRUCTIONAL PROGRAM MANAGER:

Electricity/Electronics Department

Service School Command, San Diego, California 92133

7. QUOTA CONTROL:

Naval Military Personnel Command

8. IMPLEMENTATION DATE:

Modules 15-19: 1 May 1977

Modules 20-25: 1 April 1977

9. PRIMARY MODE OF INSTRUCTION:

Self paced

10. PRECEDING CURRICULUM OUTLINE (Identification Data):

Individualized Learning Development Group

Service School Command, NTC, San Diego, California 92133

11. INSTRUMENTS AND PROCEDURES FOR MEASURING STUDENT PERFORMANCE:

CMI progress tests, CMI module tests, performance tests,

End of course comprehensive tests

12. PERSONNEL QUALIFICATIONS STANDARDS (PQS)

Not applicable

STUDENT DATA SHEET

1. PERSONNEL PHYSICAL REQUIREMENTS:

   As required by the *Manual of Qualifications for Advancement NAVPERS 18068-C*, for the specific school the student is to attend.

2. SECURITY CLEARANCE REQUIRED:

   Unclassified

3. PREREQUISITE TRAINING:

   BE/E CANTRAC A-100-0010 Modules 1 - 14

4. PERSONNEL AND RATINGS ELIGIBLE:

   All personnel in those ratings assigned to specific A-1 schools who are required to demonstrate the applied skills and knowledge of basic electricity and electronics.
   CTM, DS, DT, EM, EN, ET, ETN, ETR, EW, FTG, FTM, GSE, IC, RM, STG, STS, TD

5. OBLIGATED SERVICE:

   As determined by the specific A-1 school

6. NOBC/NEC EARNED:

   None

7. RELATED AND/OR FOLLOW-ON TRAINING:

   Specific A-1 school

8. MODULES SPECIFIED FOR THE RATING:

   Modules 15 through 25 inclusive or part thereof determined by the specific A-1 school requirements.

FOREWORD

The purpose of this curriculum outline is to provide interested activities and personnel with a compilation of learning objectives students will achieve for modules 15 through 25 of Basic Electricity and Electronics School.

The primary purpose of Modules 15-19 is to introduce the student to rudimentary troubleshooting skills. The vehicle of instruction which the student will practice and be tested on is a basic superheterodyne radio receiver with four functional stages: the power supply, audio frequency, radio frequency and intermediate frequency amplifiers. The student will not get extensive, comprehensive information about the radio receiver.

The primary purpose of modules 20-25 is to present to the student elementary electronic circuits; i.e.: power supplies, amplifiers, oscillators, multivibrators and waveshaping circuits. The primary emphasis in this entire Module series is solid state circuitry. Although electron tubes and circuits are addressed, they are explained in terms of previously discussed solid state devices and the coverage can best be described as brief.

To aid in interpolation, any 'knowledge' type learning objective included herein has a standard of 100% accuracy. Objectives which identify measurements as the testable behavior have a standard of $\pm$10%.

TABLE OF CONTENTS

FRONT MATTER	PAGE
Cover	
Course Data Page	i
Student Data Sheet	iii
Foreword	iv
CURRICULUM OUTLINE OF INSTRUCTION	
Module 15.0 - Soldering Techniques	1
Lesson Topic 15.1 - Basic Soldering Techniques	1
Module 16.0 - Introduction to Operation and Maintenance Manuals	4
Lesson Topic 16.1 - Introduction to operation and Maintenance Manuals	4
Lesson Topic 16.2 - 6B25 Operation and Maintenance Manual	5
Module 17.0 - Basic Oscilloscope Operation	6
Lesson Topic 17.1 - Operation	6
Lesson Topic 17.2 - Waveform Identification and Voltage Measurement	7
Module 18.0 - Basic Troubleshooting Techniques	9
Lesson Topic 18.1 - Signal Tracing	9
Lesson Topic 18.2 - The Six-Step Method of Troubleshooting	10
Lesson Topic 18.3 - Troubleshooting the Power Supply Stage In a Radio Receiver	10
Module 19.0 - Troubleshooting the Amplifier Stages In a Radio Receiver	12
Lesson Topic 19.1 - Basic Transistor Operation and Identification	12
Lesson Topic 19.2 - Troubleshooting the Audio Frequency (AF) Amplifier	13
Lesson Topic 19.3 - Troubleshooting the Radio Frequency (RF) Amplifier	13
Lesson Topic 19.4 - Troubleshooting the Intermediate Frequency (IF) Amplifier	14

Module 20.0 - Solid State Power Supplies - - - - - - - - - - - - - - 16
Lesson Topic 20.1 - Power Supply Functional Analysis - - - - - - - - 16
Lesson Topic 20.2 - Power Supply Input Stage - - - - - - - - - - - - 17
Lesson Topic 20.3 - Power Supply Transformer Secondary Stage - - - 18
Lesson Topic 20.4 - Power Supply Rectifiers - - - - - - - - - - - - 19
Lesson Topic 20.5 - Power Supply Filters - - - - - - - - - - - - - - 20
Lesson Topic 20.6 - Power Supply Regulators - - - - - - - - - - - - 21
Lesson Topic 20.7 - Power Supply System Concept - - - - - - - - - - 22

Module 20T.0 - Electron Tube Power Supplies - - - - - - - - - - - - 24
Lesson Topic 20T.1 - Electron Tube Power Supplies - - - - - - - - - 24

Module 21.0 - Basic Transistor Theory - - - - - - - - - - - - - - - 26
Lesson Topic 21.1 - Basic Transistor Theory - - - - - - - - - - - - 26
Lesson Topic 21.2 - Transistor Biasing - - - - - - - - - - - - - - - 27
Lesson Topic 21.3 - Basic Transistor Amplifier Functional Analysis - 29
Lesson Topic 21.4 - Basic Transistor Amplifier Configurations - - 30
Lesson Topic 21.5 - Basic Transistor Amplifier Circuit Analysis - 32

Module 21T.0 - Multi-Element Vacuum Tubes - - - - - - - - - - - - - 34
Lesson Topic 21T.1 - Multi-Element Vacuum Tubes - - - - - - - - - - 34
Lesson Topic 21T.2 - Vacuum Tube Circuit Configurations - - - - - - 35

Module 22.0 - Oscillators - 37
Lesson Topic 22.1 - Functional Analysis - - - - - - - - - - - - - - 37
Lesson Topic 22.2 - Parallel Resonant Circuits - - - - - - - - - - - 38
Lesson Topic 22.3 - Frequency Measurement With An Oscilloscope - - 38
Lesson Topic 22.4 - Oscillator Operation - - - - - - - - - - - - - - 39

Module 23.0 - Multivibrators - 42
Lesson Topic 23.1 - Bistable Multivibrator Operation (Flip-Flop) - 42
Lesson Topic 23.2 - Astable Multivibrator Operation (Free Running) 43
Lesson Topic 23.3 - Monostable Multivibrator Operation (One shot)- 44

Module 24.0 - Wave Shaping Circuits - - - - - - - - - - - - - - - - - 46
Lesson Topic 24.1 - Clippers - 46
Lesson Topic 24.2 - Clampers - 47
Lesson Topic 24.3 - Integrators/Differentiators - - - - - - - - - - 49

Module 25.0 - Special Devices - 50
Lesson Topic 25.1 - Silicon Control Rectifier Theory - - - - - - - 50
Lesson Topic 25.2 - Unijunction Transistor Theory - - - - - - - - - 51

ANNEX

Training Equipment List - 54
Training Material List ---------- 56

CURRICULUM OUTLINE OF INSTRUCTION

Contact Hours ____

	Classroom/ Learning Center	Practical Application/ Laboratory

MODULE 15.0 SOLDERING TECHNIQUES

TO 35.0 When the student completes this course, he will be able to SOLDER and DESOLDER cannon plugs, terminals, and fuse holders given a set of tools, in accordance with MILSTD 454e, requirement 5.

TO 36.0 When the student completes this course, he will be able to SOLDER and DESOLDER resistors, capacitors, diodes and REPAIR open foil runs on a printed circuit board, given a set of tools, in accordance with MILSTD 454e, requirement 5.

Lesson/Topic 15.1 Basic Soldering Techniques

TO 35.0 When the student completes this course, he will be able to SOLDER and DESOLDER cannon plugs, terminals, and fuse holders given a set of tools, in accordance with MILSTD 454e, requirement 5.

TO 36.0 When the student completes this course, he will be able to SOLDER and DESOLDER resistors, capacitors, diodes and REPAIR open foil runs on a printed circuit board, given a set of tools, in accordance with MILSTD 454e, requirement 5.

EO 15.35.1.1 Match the names of a Soldering Iron, Wire Stripper, Diagonal Pliers, Needle-nose Pliers, Chain-nose Pliers, Heat Sink(s), Clamp, Tweezer(s), Hemostat(s), Antiwicking Tool and Solder Sucker to their illustrations.

	Classroom/ Learning Center	Practical Application/ Laboratory
EO 15.35.1.2 Match the names of the soldering Iron, Wire Stripper, Diagonal Pliers, Needle-nose Pliers, Chain-nose Pliers, Heat Sink(s), Clamp, Tweezer(s), Hemostat(s), Antiwicking Tool and Solder Sucker to their functions.		
EO 15.35.1.3 SELECT the reason for using 60/40 rosin core solder when soldering on electronic/electrical circuits given a list of possible reasons.		
EO 15.35.1.4 SELECT the sequence of steps used in preparing a soldering iron or gun for soldering given a list of possible sequences.		
EO 15.35.1.5 PREPARE terminals and fuse holder for soldering given a set of soldering tools and a junction box, in accordance with MILSTD 454e, requirement 5.		
EO 15.35.1.6 PREPARE wires for soldering given a set of tools and various lengths and gauges of single and multi-strand wire in accordance with MILSTD 454e, requirement 5.		
EO 15.35.1.7 ATTACH wires to the terminals and fuse holder in a junction box given a set of tools, and wires, in accordance with MILSTD 454e, requirement 5.		
EO 15.35.1.8 SOLDER wires to terminals and fuse holders in a junction box given a set of tools, in accordance with MILSTD 454e, requirement 5.		
EO 15.35.1.8.1 MATCH the flow and sweat methods of soldering to a list of their procedures.		
EO 15.35.1.8.2 SELECT the procedure of applying heat to a connection to be soldered, given a list of procedures.		

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 15.35.1.9 ASSEMBLE a power plug and a cannon plug given a set of tools, in accordance with NAVSHIPS 0967-00-160, Section 6.

EO 15.35.1.9.1 SOLDER a cannon plug using the sweat method given a set of tools, in accordance with MILSTD 454e, requirement 5.

EO 15.35.1.10 DESOLDER terminals, fuse holders and cannon plugs given a set of tools and a junction box, in accordance with MILSTD 454e, requirement 5.

EO 15.36.1.1 SELECT the procedures for soldering components on a printed circuit board given a list of procedures.

EO 15.36.1.2 PREPARE and SOLDER resistors, capacitors and diodes on a printed circuit board, given a set of tools, in accordance with MILSTD 454e, requirement 5.

EO 15.36.1.3 DESOLDER resistors, capacitors and diodes from a printed circuit board, given a set of tools in accordance with MILSTD 454e, requirement 5.

EO 15.36.1.4 MATCH the flow and bridging methods of repairing printed circuit board foil runs given lists of their procedures.

EO 15.36.1.5 REPAIR two open foil runs on a defective printed circuit board, one using the flow method and one using the bridging method of soldering, given a set of tools, in accordance with MILSTD 454e, requirement 5.

EO 15.36.1.6 DESOLDER two foil run repairs on a printed circuit board given a set of tools, in accordance with MILSTD 454e, requirement 5.

CURRICULUM OUTLINE OF INSTRUCTION

	Contact Hours ____	Classroom/ Learning Center	Practical Application/ Laboratory

MODULE 16.0 USING A TECHNICAL MANUAL

Supported partially by this Module and partially by Modules 17.0, 18.0 and 19.0

TO 37.0 When the student completes this course he will be able to TROUBLESHOOT a basic radio receiver (RF, IF, AF, and power supply stages) to a faulty component using a technical manual, multimeter, oscilloscope and signal generator and RECORD the circuit symbol number and/or manufacturer's part number of the faulty component.

Lesson Topic 16.1 Introduction To Operation & Maintenance Manuals

Supported partially by this lesson topic and lesson topic 16.2 and Modules 17.0, 18.0 and 19.0.

TO 37.0 When the student completes this course he will be able to TROUBLESHOOT a basic radio receiver (RF, IF, AF and power supply stages) to a faulty component using a technical manual, multimeter, oscilloscope and signal generator and RECORD the circuit symbol number and/or manufacturer's part number of the faulty component.

EO 16.37.1.1 MATCH the section numbers of a Navy technical manual to their titles.

EO 16.37.1.2 MATCH each section of a seven section Navy technical manual to a list of statements describing information contained in the manual.

EO 16.37.1.3 SELECT the schematic symbols most commonly used to represent test points given a group of schematic symbols.

EO 16.37.1.4 SELECT the schematic symbols most commonly used to represent interconnection(s) given a group of schematic symbols.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 16.37.1.5 SELECT the circuit symbol number (reference symbol number) for a component, given the unit, assembly, sub-assembly, component numbers, and a list of circuit symbol numbers.

Lesson Topic 16.2 6B25 Operation & Maintenance Manual

Supported partially by the lesson topic and lesson topic 16.1 and Module 17.0, 18.0 and 19.0.

TO 37.0 When the student completes this course he will be able to TROUBLESHOOT a basic radio receiver (RF, IF, AF and power supply stages) to a faulty component using a technical manual, multimeter, oscilloscope and signal generator and RECORD the circuit symbol number and/or manufacturer's part number of the faulty component.

EO 16.37.2.1 INSTALL resistors diodes and electrolytic capacitors on a prefabricated circuit board, given a technical manual and tools. Completed board must conform to technical manual specifications and MILSTD 454e, requirement 5.

EO 16.37.2.1.1 IDENTIFY the cathode and anode of a semiconductor diode by selecting the correctly labelled schematic symbol given a group of symbols.

EO 16.37.2.1.2 IDENTIFY the anode or cathode leads of four solid state diodes given illustrations of diodes with different physical characteristics.

EO 16.37.2.1.3 IDENTIFY the proper method of testing a semiconductor diode with a multimeter by selecting and sequencing the steps required to measure a diode's front to-back-ratio.

EO 16.37.2.1.4 LABEL a schematic symbol of a semiconductor diode indicating the direction of forward current flow.

	Classroom/ Learning Center	Practical Application/ Laboratory
EO 16.37.2.1.5 DETERMINE front-to-back ratio of a semiconductor diode given a multimeter.		

CURRICULUM OUTLINE OF INSTRUCTION

Contact Hours _____ Classroom/ Learning Center | Practical Application/ Laboratory

MODULE 17.0 BASIC OSCILLOSCOPE OPERATION

Supported partially by this Module and partially by Module 16.0, 18.0 and 19.0.

TO 37.0 When the student completes this course he will be able to TROUBLESHOOT a basic radio receiver (RF, IF, AF and power supply stages) to a faulty component using a technical manual, multimeter, oscilloscope and signal generator and RECORD the circuit symbol number and/or manufacturer's part number of the faulty component.

Supported partially by this Module and partially by Module 22.0.

TO 38.0 When the student completes this course, he will be able to MEASURE with an oscilloscope and RECORD peak voltages, peak to peak voltages, frequencies and the base line reference voltages of waveforms and IDENTIFY and RECORD the types of waveforms given a 10X probe and a signal source. Measurements to be within ±10%.

Lesson Topic 17.1 Operation

Supported partially by this lesson topic and lesson topic 17.2 and Modules 16.0, 18.0 and 19.0.

TO 37.0 When the student completes this course he will be able to TROUBLESHOOT a basic radio receiver (RF, IF, AF and power supply stages) to a faulty component using a technical manual, multimeter, oscilloscope and signal generator and RECORD the circuit symbol number and/or manufacturer's part number of the faulty component.

Supported partially by this lesson topic and lesson topic 17.2 and 22.3.

TO 38.0 When the student completes this course, he will be able to MEASURE with an oscilloscope and RECORD peak voltages,

	Classroom/ Learning Center	Practical Application/ Laboratory

peak to peak voltages, frequencies and the base line reference voltages of waveforms and IDENTIFY and RECORD the types of waveforms given a 10X probe and a signal source. Measurements to be within ±10%.

EO 17.38.1.1 SELECT voltage amplitude, wave shape, phase relationship and frequency time as display capabilities of an oscilloscope given a list of capabilities.

EO 17.38.1.2 IDENTIFY the function and effect of the ON-OFF, Focus, Intensity, Scale illunination, Astigmatism, Horizontal Multiplier, Time Base, Horizontal Position, Vertical Amplitude, Vertical Position, AC-DC, Trigger Source, Stability, Trigger and Trigger Level controls with respect to an oscilloscope's presentation by matching the front panel controls to their functions and to their effects.

EO 17.38.1.3 SELECT the function of a 10X probe given a list of possible functions.

EO 17.38.1.4 CALIBRATE a 10X probe, given an uncalibrated 10X probe and an oscilloscope.

EO 17.38.1.5 IDENTIFY the steps in the procedure used to calibrate a 10X probe given a list of steps.

Lesson Topic 17.2 Waveform Identification & Voltage Measurement

Supported partially by this lesson topic and lesson topic 17.2 and Modules 16.0, 18.0 and 19.0.

TO 37.0 When the student completes this course he will be able to TROUBLESHOOT a basic radio receiver (RF, IF, AF and power supply stages) to a faulty component using a technical manual, multimeter, oscilloscope and signal generator and RECORD the circuit symbol number and/or manufacturer's part number of the faulty component.

Classroom/ Learning Center	Practical Application/ Laboratory

Supported partially by this lesson topic and lesson topic 17.1 and 22.3

TO 38.0 When the student completes this course, he will be able to MEASURE with an oscilloscope and RECORD peak voltage, peak to peak voltage, frequency, the base line reference voltage, and to IDENTIFY and RECORD types of waveforms, given a 10X probe and a signal source.

EO 17.38.2.1 IDENTIFY and RECORD the shape, and MEASURE and RECORD the base line reference level, peak voltage, and peak-to-peak voltage of a sine wave on an oscilloscope, given a signal source. Measurements must be within ±10%.

EO 17.38.2.2 IDENTIFY and RECORD the shape, and MEASURE and RECORD the base line reference level, peak voltage and peak-to-peak voltage of a square wave on an oscilloscope, given a signal source. Measurements must be within ±10%.

CURRICULUM OUTLINE OF INSTRUCTION

Contact Hours _____	Classroom/ Learning Center	Practical Application/ Laboratory

MODULE 18.0 BASIC TROUBLESHOOTING TECHNIQUES

Supported partially by this Module and partially by Modules 16.0 17.0 and 19.0.

TO 37.0 When the student completes this course he will be able to TROUBLESHOOT a basic radio receiver (RF, IF, AF and power supply stages) to a faulty component using a technical manual, multimeter, oscilloscope and signal generator and RECORD the circuit symbol number and/or manufacturer's part number of the faulty component.

Lesson Topic 18.1 Signal Tracing

Supported partially by this lesson topic and by lesson topic 18.2 and 18.3 and Modules 16.0, 17.0 and 19.0.

TO 37.0 When the student completes this course he will be able to TROUBLESHOOT a basic radio receiver (RF, IF, AF and power supply stages) to a faulty component using a technical manual, multimeter, oscilloscope and signal generator and RECORD the circuit symbol number and/or manufacturer's part number of the faulty component.

EO 18.37.1.1 SELECT the statement best representing the ICO concept given a list of statements.

EO 18.37.1.2 SELECT the purpose of Signal Tracing given a list of purposes.

EO 18.37.1.3 SELECT the purpose of Signal Injection given a list of purposes.

EO 18.37.1.4(A) POSITION the front panel controls of an AN/URM-25 signal generator to produce modulated and unmodulated sine waves.

EO 18.37.1.4(B) POSITION the front panel controls of a WAVETEK 186 signal generator to produce (1) modulated and unmodulated sine waves and (2) square waves.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 18.37.1.5 INJECT the appropriate signals at the inputs and OBSERVE the outputs of Radio Frequency/Intermediate Frequency/ Audio Frequency amplifier stages of an inoperative 6B25 radio receiver given an oscilloscope, technical manual and a signal generator. Standard will be considered accomplished when a faulty function is located.

Lesson Topic 18.2 The Six Step Method of Troubleshooting

Supported partially by this lesson topic and by lesson topic 18.1, and 18.3 and Modules 16.0, 17.0 and 19.0.

TO 37.C When the student completes this course he will be able to TROUBLESHOOT a basic radio receiver (RF, IF, AF and power supply stages) to a faulty component using a technical manual, multimeter, oscilloscope and signal generator and RECORD the circuit symbol number and/ or manufacturer's part number of the faulty component.

EO 18.37.2.1 MATCH the steps of the six-step method of troubleshooting to their sequential number.

EO 18.37.2.2 IDENTIFY the information obtained from each step of the six-step method of troubleshooting.

EO 18.37.2.3 IDENTIFY the advantages of bracketing, half-splitting and linear methods of troubleshooting given a list of statements.

EO 18.37.2.4 LOCATE and RECORD the faulty stage in a prefaulted 6B25 radio receiver using the six-step troubleshooting method given an oscilloscope and a signal generator.

	Classroom/ Learning Center	Practical Application/ Laboratory

Lesson Topic 18.3 Troubleshooting The Power Supply Stage In A Radio Receiver

Supported partially by this lesson topic and by lesson topic 18.1, and 18.3 and Modules 16.0, 17.0 and 19.0.

TO 37.0 When the student completes this course he will be able to TROUBLESHOOT a basic radio receiver (RF, IF, AF and power supply stages) to a faulty component using a technical manual, multimeter oscilloscope and signal generator and RECORD the circuit symbol number and/or manufacturer's part number of the faulty component.

EO 18.37.3.1 LOCATE a faulty component in a 6B25 radio receiver power supply using the six-step troubleshooting method and RECORD the faulty component's circuit symbol and manufacturer's part number given a multimeter, a signal generator, a technical manual and an oscilloscope.

EO 18.37.3.1.1 SELECT the function of a power supply given a list of statements.

EO 18.37.3.1.2 SELECT the functions of a rectifier, filter, and regulator given a list of statements.

CURRICULUM OUTLINE OF INSTRUCTION

Contact Hours _____ Classroom/ Learning Center | Practical Application/ Laboratory

MODULE 19.0 TROUBLESHOOTING THE AMPLIFIER STAGES IN A RADIO RECEIVER

Supported partially by this module and partially by Modules 16.0, 17.0 and 18.0.

TO 37.0 When the student completes this course he will be able to TROUBLESHOOT a basic radio receiver (RF, IF, AF and power supply stages) to a faulty component using a technical manual, multimeter, oscilloscope and signal generator and RECORD the circuit symbol number and/or manufacturer's part number of the faulty component.

Lesson Topic 19.1 Basic Transistor Operation And Identification

Supported partially by this lesson topic and lesson topic 19.2, 19.3, and 19.4 and Modules 16.0, 17.0 and 18.0.

TO 37.0 When the student completes this course he will be able to TROUBLESHOOT a basic radio receiver (RF, IF, AF and power supply stages) to a faulty component using a technical manual, multimeter, oscilloscope and signal generator and RECORD the circuit symbol number and/or manufacturer's part number of the faulty component.

EO 19.37.1.1 SELECT the function of a transistor giver a list of statements.

EO 19.37.1.1.1 SELECT the schematic symbols for PNP and NPN transistors given a group of symbols.

EO 19.37.1.1.2 IDENTIFY the emitter, base and collector leads of a NPN and PNP transistor given schematic symbols of NPN and PNP transistors.

EO 19.37.1.1.3 SELECT the correct paths for current flow through a transistor given transistor schematic symbols showing paths of current flow.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 19.37.1.1.4 IDENTIFY the leads of a transistor given an illustration of a transistor.

EO 19.37.1.1.5 IDENTIFY the proper method of testing a transistor with a multimeter by selecting and sequencing the steps.

Lesson Topic 19.2 Troubleshooting The Audio Frequency (AF) Amplifier

Supported partially by this lesson topic and by lesson topic 19.1, 19.3, and Modules 16.0, 17.0 and 18.0.

TO 37.0 When the student completes this course he will be able to TROUBLESHOOT a basic radio receiver (RF, IF, AF and power supply stages) to a faulty component using a technical manual, multimeter, oscilloscope and signal generator and RECORD the circuit symbol number and/or manufacturer's part number of the faulty component.

EO 19.37.1 TROUBLESHOOT the Audio Frequency amplifier stage of a 6B25 Radio Receiver to a faulty component using the six-step method of troubleshooting, given a prefaulted amplifier stage, multimeter, signal generator, oscilloscope, and technical manual. Standard will be considered accomplished when faulty component has been identified by circuit symbol and manufacturer's part number.

EO 19.37.2.1.1 SELECT the functions of the AF amplifier given a list of functions.

EO 19.37.2.1.2 IDENTIFY the signal path through the AF amplifier by selecting the schematic diagram of an amplifier with the correct signal path shown from a group of AF amplifier schematic diagrams.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 19.37.2.1.3 IDENTIFY the signal at the check points of an AF amplifier schematic given the schematic diagram of the AF amplifier with the signal check points labeled.

Lesson Topic 19.3 Troubleshooting The Radio Frequency (RF) Amplifier

Supported partially by this lesson topic and by lesson topic 19.1, 19.2, and 19.4 and Modules 16.0, 17.0, and 18.0.

TO 37.0 When the student completes this course he will be able to TROUBLESHOOT a basic radio receiver (RF, IF, AF and power supply stages) to a faulty component using a technical manual, multimeter, oscilloscope and signal generator and RECORD the circuit symbol number and/or manufacturer's part number of the faulty component.

EO 19.37.3.1 TROUBLESHOOT the Radio Frequency amplifier stage of a 6B25 Radio Receiver to a faulty component using the six-step method of troubleshooting, given a prefaulted amplifier stage, multimeter, signal generator, oscilloscope, and technical manual. Standard will be considered accomplished when faulty component has been identified by circuit symbol and manufacturer's part number.

EO 19.37.3.1.1 SELECT the functions of the RF amplifier given a list of functions.

EO 19.37.3.1.2 IDENTIFY the signal path through the RF amplifier by selecting the schematic diagram of an amplifier with the correct signal path shown from a group of RF amplifier schematic diagrams.

EO 19.37.3.1.3 IDENTIFY the signal at the check points of an RF amplifier schematic given the schematic diagram of the RF amplifier with the signal check points labeled.

	Classroom/ Learning Center	Practical Application/ Laboratory

Lesson Topic 19.4 Troubleshooting The Intermediate Frequency (IF) Amplifier

Supported partially by this lesson topic and partially by lesson topic 19.1, 19.2, and 19.3 and Modules 16.0, 17.0 and 18.0

TO 37.0 When the student completes this course he will be able to TROUBLESHOOT a basic radio receiver (RF, IF, AF and power supply stages) to a faulty component using a technical manual, multimeter, oscilloscope and signal generator and RECORD the circuit symbol number and/or manufacturer's part number of the faulty component.

EO 19.37.4.1 TROUBLESHOOT the Intermediate Frequency amplifier stage of a 6B25 Radio Receiver to a faulty component using the six-step method of troubleshooting, given a prefaulted amplifier stage, multimeter, signal generator, oscilloscope, and technical manual. Standard will be considered accomplished when faulty component has been identified by circuit symbol and manufacturer's part number.

EO 19.37.4.1.1 SELECT the functions of the IF amplifier given a list of functions.

EO 19.37.4.1.2 IDENTIFY the signal path through the IF amplifier by selecting the schematic diagram of an amplifier with the correct signal path shown from a group of IF amplifier schematic diagrams.

EO 19.37.4.1.3 IDENTIFY the signal at the check points of an IF amplifier schematic given the schematic diagram of the IF amplifier with the signal check points labeled.

CURRICULUM OUTLINE OF INSTRUCTION

Contact Hours _____ Classroom/ Learning Center | Practical Application/ Laboratory

MODULE 20.0 SOLID STATE POWER SUPPLIES

Supported partially by this lesson topic and partially by Module 1 through 19

TO 40.0 When the student completes this course, he will be able to TROUBLESHOOT two (one at a time) faulty solid state power supplies to the component level, given a training device, multimeter, oscilloscope, and schematic diagrams. Repair work will be done with similar components on a practice card. Fault diagnosis to be 100% correct with repair work passing a Learning Center Instructor's visual and physical check.

Lesson Topic 20.1 Power Supply Functional Analysis

TO 40.0 When the student completes this course, he will be able to TROUBLESHOOT Two (one at a time) faulty solid state power supplies to the component level, giving a training device, multimeter, oscilloscope, and schematic diagrams. Repair work will be done with similar components on a practice card. Fault diagnosis to be 100% correct with repair work passing a Learning Center Instructor's visual and physical check.

EO 20.1.40.1 RECOGNIZE the overall function of an electronic power supply by selecting the correct statement from a list of possible choices, only one of which is correct. 100% accuracy is required.

EO 20.1.40.1.1 IDENTIFY the functions of the input stage (circuit) of an electronic power supply by selecting the correct functions from a list of several choices. 100% accuracy is required.

EO 20.1.40.1.2 IDENTIFY the function of the rectifier stage of a power supply by selecting the correct function from a list of several choices. 100% accuracy is required.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 20.1.40.1.3 IDENTIFY the function of the transformer secondary of an electronic power supply by selecting the correct statement of the function of the transformer secondary in an electronic power supply from a list of four statements, only one of which is correct. 100% accuracy is required.

EO 20.1.40.1.4 IDENTIFY the function of the filter stage of an electronic power supply by selecting the correct statement of the function of the filter stage of a basic power supply from a list of several choices, only one of which is correct. 100% accuracy is required.

EO 20.1.40.1.5 IDENTIFY the function of the regulator stage of an electronic power supply by selecting the correct statement of the function of the regulator stage of a basic power supply from a list of several statements, only one of which is correct. 100% accuracy is required.

Lesson Topic 20.2 Power Supply Input Stage

TO 40.0 When the student completes this course, he will be able to TROUBLESHOOT two (one at a time) faulty solid state power supplies to the component level, given a training device, multimeter, oscilloscope, and schematic diagrams. Repair work will be done with similar components on a practice card. Fault diagnosis to be 100% correct with repair work passing a Learning Center Instructor's visual and physical check.

EO 20.2.40.2 ANALYZE the function of the input stage of an electronic power supply by observing, recording and interpreting waveforms and voltages at indicated test points on a training device. All recorded data must fall within specifications as stated in the job program.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 20.2.40.2.1 IDENTIFY the function of an electronic circuit breaker by selecting the correct statement of a function of a circuit breaker from a list of several statements, only one of which is correct. 100% accuracy is required.

EO 20.2.40.2.2 IDENTIFY the function of an indicator light connected across the primary of the power supply transformer by selecting the correct statement from a list of several statements, only one of which is correct. 100% accuracy is required.

EO 20.2.40.2.3 MATCH physical components found in the input stage of an electronic power supply with their proper schematic symbols, given typical components and a list of symbols. 100% accuracy is required.

Lesson Topic 20.3 Power Supply Transformer Secondary Stage

TO 40.0 When the student completes this course, he will be able to TROUBLESHOOT two (one at a time) faulty solid state power supplies to the component level, given a training device, multimeter, oscilloscope, and schematic diagrams. Repair work will be done with similar components on a practice card. Fault diagnosis to be 100% correct with repair work passing a Learning Center Instructor's visual and physical check.

EO 20.3.40.3 ANALYZE the function of the first conversion stage (transformer secondary) of the basic power supply by observing, measuring, and recording the normal waveforms and voltages at the transformer secondary test-points and interpreting the differences in the primary and secondary measurements, given test equipment, training device, and a job program. All measured data must fall within tolerances as stated in the job program.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 20.3.40.3.1 IDENTIFY the function of a multi-secondary electronic transformer by selecting the correct statement of the function of a multi-secondary transformer from a list of several choices, only one of which is correct. 100% accuracy is required.

EO 20.3.40.3.2 IDENTIFY the function of a center-tapped secondary of an electronic power supply transformer by selecting the correct statement of the function of a center-tapped secondary in a power supply transformer from a list of several choices, only one of which is correct. 100% accuracy is required.

EO 20.3.40.3.3 LOCATE the three power supply transformer secondary connections in the electronic power supply using a training device and a schematic of the power supply circuit. All three connections must be correctly identified.

Lesson Topic 20.4 Power Supply Rectifiers

TO 40.0 When the student completes this course, he will be able to TROUBLESHOOT two (one at a time) faulty solid state power supplies to the component level, given a training device, multimeter, oscilloscope, and schematic diagrams. Repair work will be done with similar components on a practice card. Fault diagnosis to be 100% correct with repair work passing a Learning Center Instructor's visual and physical check.

EO 20.4.40.4 DIFFERENTIATE between the schematic drawings of half-wave, full-wave, and bridge rectifier circuits by matching each of three schematics with its correct type name. 100% accuracy is required.

EO 20.4.40.5 MATCH illustrations to statements about the effects of applying forward bias to a diode, given four choices only one of which is correct concerning forward bias. 100% accuracy is required.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 20.4.40.6 MATCH illustrations to statements about the effects of applying reverse bias to a diode, given four choices only one of which is correct concerning reverse bias. 100% accuracy is required.

EO 20.4.40.7 MATCH the drawings of output waveforms of half-wave, full-wave, and bridge rectifier circuits with their correct names, given choices of names and drawings. Each waveform must be correctly named.

EO 20.4.40.8 MEASURE the resistances and CALCULATE front-to-back ratios of diodes, given four different types of diodes, a job program, and a multimeter. All measurements and ratios to fall within tolerances specified on the job program.

EO 20.4.40.9 MATCH the physical components of the second conversion stage of an electronic power supply with their respective schematic symbols, given a schematic diagram, a job program, and a training device power supply. 100% accuracy is required.

EO 20.4.40.9.1 IDENTIFY the location of components, letter/number designations, and test points of the second conversion state of an electronic power supply as required on the job program, given a schematic diagram and a training device power supply. 100% accuracy is required.

Lesson Topic 20.5 Power Supply Filters

TO 40.0 When the student completes this course he will be able to TROUBLESHOOT two (one at a time) faulty solid state power supplies to the component level, given a training device, multimeter, oscilloscope, and schematic diagrams. Repair work will be done with similar components on a practice card. Fault diagnosis to be 100% correct with repair work passing a Learning Center Instructor's visual and physical check.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 20.5.40.10 OBSERVE, MEASURE, and INTERPRET the output waveforms and voltages from the filter stage of an electronic power supply, given an oscilloscope, and a training device. Readings must be within specified tolerances.

EO 30.5.40.10.1 IDENTIFY schematic configurations of capacitor input, choke input, and pi type filters of electronic power supplies, given schematic configurations of each. 100% accuracy is required.

EO 20.5.40.10.2 IDENTIFY the output waveform of an electronic power supply filter circuit, given drawings of various waveforms only one of which is correct. 100% accuracy is required.

Lesson Topic 20.6 Power Supply Regulators

TO 40.0 When the student completes this course he will be able to TROUBLESHOOT two (one at a time) faulty solid state power supplies to the component level, given a training device, multimeter, oscilloscope, and schematic diagrams. Repair work will be done with similar components "on a practice card. Fault diagnosis to be 100% correct with repair work passing a Learning Center Instructor's visual and physical check.

EO 20.6.40.11 OBSERVE, MEASURE and INTERPRET the voltage at the power supply regulator output wieh (1) input voltages change and (2) when loads are added, given a VOM, schematic diagram, a job program, and a training device with provisions for varying line voltage and load conditions. Readings to be within tolerances specified in the job program.

EO 20.6.40.11.1 IDENTIFY the function of a series regulator by selecting the statement best describing the function of an electronic series regulator, given an illustration and a set of statements. 100% accuracy is required.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 20.6.40.11.2 IDENTIFY the function of a shunt regulator by selecting the statement best describing the function of an electronic shunt regulator, given an illustration and a set of statements. 100% accuracy is required.

EO 20.6.40.11.3 IDENTIFY the function of a Zener diode acting as a voltage regulator in a power supply by selecting the most correct statement from a list of statements, one of which correctly describes the functions of a Zener diode, given an illustration and a set of statements. 100% accuracy is required.

EO 20.6.40.11.4 MATCH the physical components of the output stage of an electronic power supply with their respective schematic symbols given a schenatic diagram, a job program, and a training device power supply. 100% accuracy is required.

EO 20.6.40.11.4.1 IDENTIFY the location of components, letter number designations and test points of the output stage of an electronic power supply as required on the job program given a schematic diagram and a training device power supply. 100% accuracy is required.

Lesson Topic 20.7 Power Supply System Concept

TO 40.0 When the student completes this course he will be able to TROUBLESHOOT two (one at a time) faulty solid state power supplies to the component level, given a training device, multimeter, oscilloscope, and schematic diagrams. Repair work will be done with similar components on a practice card. Fault diagnosis to be 100% correct with repair work passing a Learning Center Instructor's visual and physical check.

	Classroom/ Learning Center	Practical Application/ Laboratory
EO 20.7.40.12 OBSERVE, MEASURE, RECORD and INTERPRET the normal waveforms at the output from each stage of an electronic power supply when each stage is in a loaded condition, given a training device, schematic diagrams, a job program, and an oscilloscope. Reading to fall within specified tolerances.		
EO 20.7.40.13 IDENTIFY how changes in current requirements are compensated for in an electronic power supply by selecting the correct statement from a list, given a list of choices only one of which is correct. 100% accuracy is required.		
EO 20.7.40.14 IDENTIFY the stage of an electronic power supply showing the most noticeable output waveform change as a result of interstage loading by selecting the correct statement concerning such change, given a list of statements only one of which is correct. 100% accuracy is required.		
EO 20.7.40.14.1 DEFINE the cause of "loading" by selecting the correct statement of the cause of loading of an electronic system, given a list of statements only one of which is correct. 100% accuracy is required.		
EO 20.7.40.14.2 STATE the effect(s) of "loading" of an electronic system by selecting the correct statement of the effect(s) of loading given a list of statements only one of which is correct. 100% accuracy is required.		

CURRICULUM OUTLINE OF INSTRUCTION

Contact Hours _____	Classroom/ Learning Center	Practical Application/ Laboratory

MODULE 20T.0 ELECTRON TUBE POWER SUPPLIES

Supported partially by this Module and partially by Module 20.

TO 41.0 When the student completes this course, he will be able to DESCRIBE the functional and voltage similarities or differences between tube and solid state power supplies by selecting the correct statement(s) concerning these similarities and/or differences from a given list of statements. 100% accuracy is required.

Lesson Topic 20T.1 Electron Tube Power Supplies

TO 41.0 When the student completes this course, he will be able to DESCRIBE the functional and voltage similarities or differences between tube and solid state power supplies by selecting the correct statement(s) concerning these similarities and/or differences from a given list of statements. 100% accuracy is required.

EO 20T.1.41.1 DIFFERENTIATE between tube and solid state power supply input circuits by choosing the correct statement(s) concerning similarities/differences, given a set of statements. 100% accuracy is required.

EO 20T.1.41.2 STATE the general similarities and/or differences in tube type and solid state power supply transformer secondaries by selecting the best statement of similarities and/or differences, given a choice of four statements. 100% accuracy is required.

EO 20T.1.41.3 COMPARE the fundamental circuit differences and/or similarities in the tube type and solid state rectifier circuits by selecting the most correct statement, given a set of four choices. 100% accuracy is required.

	Classroom/ Learning Center	Practical Application/ Laboratory
EO 20T.1.41.4 COMPARE the schematic symbols and direction of current flow of a tube type diode to a solid state diode by selecting the correct illustration from a given set of illustrations showing directions of current flow through tube type and solid state diodes. 100% accuracy is required.		
EO 20T.1.141.5 COMPARE and CONTRAST the function/size/configuration of solid state and tube type power supply filter networks by selecting the correct statement(s) concerning the above differences/similarities from a set of given statements. 100% accuracy is required.		
EO 20T.1.41.6 COMPARE and CONTRAST the functions and/or circuit configurations of tube type and Zener diode regulators by selecting the correct statement(s) concerning the above differences/similarities from a set of given statements. 100% accuracy is required.		

CURRICULUM OUTLINE OF INSTRUCTION

Contact Hours _____ Classroom/ Learning Center | Practical Application/ Laboratory

MODULE 21.0 BASIC TRANSISTOR THEORY

Supported partially by this Module and partially by Modules 1 through 20.

TO 42.0 When the student completes this course, he will be able to TROUBLESHOOT an audio amplifier training device, given the required test equipment, schematic diagram, and a prefaulted audio amplifier. Faults to be limited to open or shorted components; no more than one fault per problem. Remove/ replace a similar component on a practice card. 100% accuracy is required.

Lesson Topic 21.1 Basic transistor Theory

TO 42.0 When the student completes this course, he will be able to TROUBLESHOOT an audio amplifier training device, given the required test equipment, schematic diagram, and a prefaulted audio amplifier. Faults to be limited to open or shorted components; no more than one fault per problem. Remove/ replace a similar component on a practice card. 100% accuracy is required.

EO 21.1.42.1 COMPARE the operation of a transistor to a variable resistor, by selecting the correct statement from a group of four or identifying the correct circuit configuration with 100% accuracy.

EO 21.1.42.1.1 SELECT the schematic symbol for the component which functions most like a transistor from a choice of four schematic symbols of non-active components. 100% accuracy is required.

EO 21.1.42.1.2 ANALYZE the effects of a change in circuit resistance on current and voltage by selecting the correct voltage/current relationships from a group of four, given a schematic diagram of a circuit containing a source connected to a variable resistor in series with a load. 100% accuracy is required.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 21.1.42.1.3 DETERMINE the resultant qualitative voltage drop across a transistor when that transistor's conductivity increases/decreases, by selecting the correct choice from a list of four possible choices. 100% accuracy is required.

EO 21.1.42.1.4 IDENTIFY the schematic symbol for a three element PNP transistor by selecting the correct symbol from a set of four choices. 100% accuracy is required.

EO 21.1.42.1.5 IDENTIFY the schematic symbol for a three element NPN transistor by selecting the correct symbol from a set of four choices. 100% accuracy is required.

EO 21.1.42.1.6 IDENTIFY the name of each lead on a transistor schematic symbol by matching the correct name, from the list provided, with each lead as numbered on the schematic symbol shown. 100% accuracy is required.

EO 21.1.42.1.7 IDENTIFY the collector, base, and emitter leads on an actual transistor, given a transistor. 100% accuracy is required.

EO 21.1.42.1.8 IDENTIFY the major current flow through an NPN/PNP transistor by selecting the schematic symbol for an NPN/PNP transistor which correctly illustrates the major current flow from a list of transistor schematic symbols. 100% accuracy is required.

Lesson Topic 21.2 Transistor Biasing

TO 42.0 When the student completes this course, he will be able to TROUBLESHOOT an audio amplifier training device, given the required test equipment, schematic diagram, and a prefaulted audio amplifier. Faults to be limited to open or shorted components; no more than one fault per problem. Remove/replace a similar component on a practice card. 100% accuracy is required.

	Classroom/ Learning Center	Practical Application/ Laboratory
EO 21.2.42.3 DEFINE the function or purpose of (1) the transistor, (2) static/dynamic bias, and (3) stabilization in the conversion stage of an amplifier by selecting the correct statement from a list of four choices, only one of which is correct. 100% accuracy is required.		
EO 21.2.42.3.1 DEFINE static/dynamic bias by selecting the best statement from a list provided. 100% accuracy is required.		
EO 21.2.42.3.2 SELECT the PNP and the NPN transistor schematic symbols labelled with relative voltage polarities (bias) which will enable each of them to conduct, given sets of 4 schematics)one set for each type), one of which is properly polarized. 100% accuracy is required.		
EO 21.2.42.3.3 DETERMINE a transistor amplifier's maximum peak-to-peak output, given a transistor amplifier circuit with Vcc indicated and a list of four choices, only one of which is correct. 100% accuracy is required.		
EO 21.2.42.3.4 IDENTIFY the basic reason for providing stabilization in a transistorized circuit by selecting the correct statement from a set of four choices only one of which is correct. 100% accuracy is required.		
EO 21.2.42.3.5 IDENTIFY the stabilizing component(s) in a schematic diagram of a basic common emitter amplifier circuit by selecting the correct stabilizing component from a set of four choices only one of which is correct. 100% accuracy is required.		
EO 21.2.42.3.6 SELECT the name of the transistor element that controls current flow through the transistor, from a list of names including collector, emitter, and base. 100% accuracy is required.		

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 21.2.42.3.7 ANALYZE the effects on the conduction of a PNP (NPN) transistor when a positive (or negative) input alternation is applied to the base by selecting from a choice of four statements only one of which is correct. 100% accuracy is required.

EO 21.2.42.12 OBSERVE and MEASURE the bias and its effects on a transistor amplifier given a training device, an oscilloscope, and a multimeter. 100% accuracy is required.

EO 21.2.42.13 OBSERVE the effects of temperature on the conduction of a transistor given a training device, and a multimeter. 100% accuracy is required.

Lesson Topic 21.3 Basic Transistor Amplifier Functional Analysis

TO 42.0 When the student completes this course, he will be able to TROUBLESHOOT an audio amplifier training device, given the required test equipment, schematic diagram, and a prefaulted audio amplifier. Faults to be limited to open or shorted components; no more than one fault per problem. Remove/ replace a similar component on a practice card. 100% accuracy is required.

EO 21.3.42.2 IDENTIFY and locate the input section components on the basic audio amplifier training device, given a training device, technical manual or schematic diagram, and the required equipment.

EO 21.3.42.4 DEFINE the function of an amplifier by choosing the correct statement from a list of four choices. 100% accuracy is required.

EO 21.3.41.4.1 DEFINE the functions of each section (input, conversion, and output) of an audio frequency amplifier by selecting all of the correct statements for each from a list including (1) blocking D.C., (2) amplification, and (3) coupling. 100% accuracy is required.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 21.3.42.5 DESCRIBE the major differences between R-C and transformer coupling by selecting the correct statement when given four statements comparing R-C and transformer coupling. Only one statement is completely correct. 100% accuracy is required.

EO 21.3.42.6 DETERMINE, using the gain formula, the current gain ration of an amplifier, given an amplifier's input and output current value. 100% accuracy is required.

EO 21.3.42.7 LOCATE, physically and schematically, the output section and test point(s) of an audio amplifier and MEASURE the output signal voltage given an audio amplifier circuit or printed circuit board, a technical manual or schematic diagram, and a multimeter or oscilloscope. Locate all test points with 100% accuracy and measure the output signal voltage within ± 10%.

EO 21.3.42.8 LOCATE, physically and schematically, the conversion and test point(s) of an audio amplifier and MEASURE the output signal voltage given an audio amplifier circuit or printed circuit board, a technical manual or schematic diagram, and a multimeter or oscilloscope. Locate all test points with 100% accuracy and measure the output signal voltage within ± 10%.

EO 21.3.42.9 LOCATE a faulty conversion section component in a basic audio amplifier, given a technical manual (or schematic), a circuit or circuit board containing at least one amplifier stage, a multimeter, signal generator, and an oscilloscope. 100% accuracy is required.

	Classroom/ Learning Center	Practical Application/ Laboratory

Lesson Topic 21.4 Basic Transistor Amplifier Configurations

TO 42.0 When the student completes this course he will be able to TROUBLESHOOT an audio amplifier training device, given the required test equipment, schematic diagram, and a prefaulted audio amplifier. Faults to be limited to open or shorted components; no more than one fault per problem. Remove/replace a similar component on a practice card. 100% accuracy is required.

EO 21.4.42.14 IDENTIFY the schematic symbol, phase shift, and current gain of the common base, common collector and common emitter transistor configurations, given schematics of these configurations and a list of statements only one of which is correct. 100% accuracy is required.

EO 21.4.42.14.1 OBSERVE the operation of the following transistor amplifiers, common emitter, common collector, and common base with regard to gain characteristics, gain, and phase inversion given a training device, an oscilloscope, and a signal generator. 100% accuracy is required.

Lesson Topic 21.5 Basic Transistor Amplifier Circuit Analysis

TO 42.0 When the student completes this course, he will be able to TROUBLESHOOT an audio amplifier training device, given the required test equipment, schematic diagram, and a prefaulted audio amplifier. Faults to be limited to open or shorted components; no more than one fault per problem. Remove/replace a similar component on a practice card. 100% accuracy is required.

EO 21.5.42.10 IDENTIFY the conditions under which a push-pull amplifier may be used selecting the correct statement (with regard to power output) from a list of four choices. 100% accuracy is required.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 21.5.42.10.1 IDENTIFY the electrical characteristic of a transistor that is "cut off" by selecting the most correct statement from a choice of four statements. 100% accuracy is required.

EO 21.5.42.10.2 IDENTIFY the electrical characteristics of a transistor that is "saturated" by selecting the most correct statement from a choice of four statements. 100% accuracy is required.

EO 21.5.42.10.3 DEFINE Class A bias by selecting the correct definition from a list of four choices. 100% accuracy is required.

EO 21.5.42.10.4 DEFINE Class B bias by selecting the correct statement from a list of four choices. 100% accuracy is required.

EO 21.5.42.10.5 OBSERVE the cut off and saturation states of a transistor by measuring the collector and base biasing voltages, given an oscilloscope, a training device and a job program. 100% accuracy is required.

EO 21.5.42.10.6 OBSERVE Class A and Class B biasing by viewing the output of a transistor amplifier, given an oscilloscope, a training device, and a job program. 100% accuracy is required.

EO 21.5.42.10.7 IDENTIFY basic push-pull amplifier configurations by selecting a schematic of a push-pull amplifier configuration from a choice of four schematics. 100% accuracy is required.

EO 21.5.42.10.8 IDENTIFY the purpose of a phase splitter circuit or device by selecting the correct statement from a list of four choices. 100% accuracy is required.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 21.5.42.10.9 SELECT those circuits containing a phase splitter, given four schematic circuit diagrams. 100% accuracy is required.

EO 21.5.42.11 DESCRIBE a complementary-symmetry amplifier by selecting the correct description from a list of four choices. 100% accuracy is required.

EO 21.5.42.11.1 IDENTIFY those circuits not containing a phase splitter, given four schematic circuit diagrams. 100% accuracy us required.

EO 21.5.42.11.2 VERIFY the proper operation of a push-pull amplifier by viewing its operation, given an oscilloscope, a training device, and accessories. 100% accuracy is required.

CURRICULUM OUTLINE OF INSTRUCTION

Contact Hours _____	Classroom/ Learning Center	Practical Application/ Laboratory

MODULE 21T.0 MULTI-ELEMENT VACUUM TUBES

Supported partially by this Module and partially by Modules 1 through 21

TO 43.0 When the student completes this course, he will be able to IDENTIFY the operational similarities and differences that exist between tubes and transistors by comparing similar circuit applications. 100% accuracy is required.

Lesson Topic 21T.1 Multi-Element Vacuum Tubes

TO 43.0 When the student completes this course, he will be able to IDENTIFY the operational similarities and differences that exist between tubes and transistors by comparing similar circuit applications. 100% accuracy is required.

EO 21T.1.43.1 IDENTIFY the elements of a triode tube by selecting the correct name for each element, given a schematic symbol and four choices of names. 100% accuracy is required.

EO 21T.1.43.2 IDENTIFY the method of controlling current flow through a triode to obtain signal amplification by selecting the correct statement from a set of four choices. 100% accuracy is required.

EO 21T.1.43.3 IDENTIFY a solid state device having current flow characteristics most like a triode vacuum tube by selecting the correct device from a list of four choices. 100% accuracy is required.

EO 21T.1.43.4 IDENTIFY a condition that will cause a triode vacuum tube to "cut off" by choosing the most correct statement from a set of four choices. 100% accuracy is required.

		Classroom/ Learning Center	Practical Application/ Laboratory
EO	21T.1.43.5 IDENTIFY a condition that will cause a triode vacuum tube to "saturate" by choosing the most correct statement from a set of four choices. 100% accuracy is required.		
EO	21T.1.43.6 IDENTIFY the screen grid in a tetrode vacuum tube given a schematic symbol of a tetrode vacuum tube. 100% accuracy is required.		
EO	21T.1.43.7 IDENTIFY the function of a screen grid in a vacuum tube by selecting the correct statement from a set of four choices. 100% accuracy is required.		
EO	21T.1.43.8 IDENTIFY three major advantages a pentode tube has over a tetrode tube or a triode tube by selecting the statement containing all three advantages in it. 100% accuracy is required.		

Lesson Topic 21T.2 Vacuum Tube Circuit Configurations

TO	43.0 When the student completes this course, he will be able to IDENTIFY the operational similarities and differences that exist between tubes and transistors by comparing similar circuit applications. 100% accuracy is required.		
EO	21T.2.43.9 IDENTIFY by selecting, the solid state amplifier configuration (CB, CE, CC) most like a grounded cathode amplifier, given four choices only one of which is correct. 100% accuracy is required.		
EO	21T.2.43.9.1 IDENTIFY by selecting the output voltage waveform of a grounded cathode amplifier circuit given a schematic diagram of a grounded cathode amplifier, an input waveform, and a set of four waveform choices only one of which is correct. 100% accuracy is required.		

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 21T.2.43.10 IDENTIFY by selecting the solid state amplifier circuit (CB, CC, CE) most like a grounded grid amplifier circuit, given four choices, only one of which is correct. 100% accuracy is required.

EO 21T.2.43.10.1 IDENTIFY by selecting the output voltage waveform of a grounded grid amplifier, an input waveform, and a choice of four waveforms, only one of which is correct. 100% accuracy is required.

EO 21T.2.43.11 IDENTIFY by selecting the solid state amplifier circuit (CB, CC, CE) most like a cathode follower circuit given four statements, only one of which is correct. 100% accuracy is required.

EO 21T.2.43.11.1 IDENTIFY by selecting the output voltage waveform of a cathode follower amplifier circuit given a schematic diagram of a cathode follower amplifier, an input waveform, and a choice of four output waveforms, only one of which is correct. 100% accuracy is required.

EO 21T.2.43.12 IDENTIFY by selecting a schematic diagram of a tube-type phase splitter circuit, given four schematic diagrams, only one of which is correct. 100% accuracy is required.

EO 21T.2.43.13 IDENTIFY by selecting a schematic diagram of a tube-type push-pull amplifier circuit, given four schematic diagrams, only one of which is correct. 100% accuracy is required.

EO 21T.2.43.14 VERIFY the proper operation of vacuum tube amplifier configurations (CC, CG, CP) by observing the input and the output of the amplifier given a oscilloscope, training device, and a job program. 100% accuracy is required.

EO 21T.2.43.15 OPERATE a tube tester by testing various types of tubes given a tube tester, a box of tubes, and a job program. 100% accuracy is required.

CURRICULUM OUTLINE OF INSTRUCTION

Contact Hours _____ Classroom/ Learning Center | Practical Application/ Laboratory

MODULE 22.0 OSCILLATORS

Supported partially by this Module and partially by Module 1 through 21

TO 44.0 When the student completes this course, he will be able to TROUBLESHOOT an oscillator circuit, given a training device, required test equipment, technical manuals, schematics, and a practice board. Fault diagnosis to be 100% correct and any repair work completed on a practice board to pass a Learning Center Instructor's visual and physical check.

Lesson Topic 22.1 Functional Analysis

TO 44.0 When the student completes this course, he will be able to TROUBLESHOOT an oscillator circuit, given a training device, required test equipment, technical manuals, schematics, and a practice board. Fault diagnosis to be 100% correct and any repair work completed on a practice board to pass a Learning Center Instructor's visual and physical check.

EO 22.1.44.1 DEFINE the function of a basic oscillator by selecting the correct statement from a list of four statements. 100% accuracy is required.

EO 22.1.44.2 IDENTIFY the tank, amplifier, and feedback components in a basic oscillator given a training device iscillator circuit and its schematic diagram or technical manual and a job program. 100% accuracy is required.

EO 22.1.44.2.1 DEFINE the function of the tank circuit in an oscillator by selecting the correct statement from a list of four choices. 100% accuracy is required.

EO 22.1.44.2.2 DEFINE the function of the amplifier section in an oscillator circuit by selecting the correct statement from a list of four choices. 100% accuracy is required.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 22.1.44.2.3 DEFINE the function of the feedback section or "loop" in an oscillator by selecting the correct statement from a list of four statements. 100% accuracy is required.

Lesson Topic 22.2 Parallel Resonant Circuits

TO 44.0 When the student completes this course, he will be able to TROUBLESHOOT an oscillator circuit, given a training device, required test equipment, technical manuals, schematics, and a practice board. Fault diagnosis to be 100% correct and any repair work completed on a practice board to pass a Learning center Instructor's visual and physical check.

EO 22.2.44.3 IDENTIFY the output waveform of a tank circuit operating at resonance by selecting an illustration of the correct waveform from a set of four illustrations. 100% accuracy is required.

EO 22.2.44.4 IDENTIFY the waveform that represents a "damped" sinewave by selecting the correct waveform from a set of four. 100% accuracy is required.

EO 22.2.44.4.1 OBSERVE a damped waveform given an oscilloscope, a training device, and a job program. 100% accuracy is required.

EO 22.2.44.5 IDENTIFY the component that, when changed, will vary the resonant frequency of a parallel tank circuit by selecting from a list of four statements the component that, when changed, will change the resonant frequency. 100% accuracy is required.

Lesson Topic 22.3 Frequency Measurement With An Oscilloscope

	Classroom/ Learning Center	Practical Application/ Laboratory

TO 44.0 When the student completes this course, he will be able to TROUBLESHOOT an oscillator circuit, given a training device, required test equipment, technical manuals, schematics, and a practice board. Fault diagnosis to be 100% correct and any repair work completed on a practice board to pass a Learning Center Instructor's visual and physical check.

EO 22.3.44.6 DETERMINE the frequency of a signal, given an oscilloscope, a job program, and a test signal generator set to a frequency unknown to the students, to within a tolerance of ± 5%.

EO 22.3.44.6.1 IDENTIFY an illustration of a waveform with one cycle correctly marked by selecting the correct choice from a set of four illustrations. 100% accuracy is required.

EO 22.3.44.6.2 DETERMINE, by calculation, the period of a waveform, given an illustration of a waveform on a graticule and a Time/Div control position setting. 100% accuracy is required.

EO 22.3.44.6.3 DETERMINE, by calculation, the frequency of waveform, given the period of the waveform. 100% accuracy is required.

EO 22.3.44.6.4 DETERMINE, by calculation, the frequency of a waveform, given an illustration of a waveform on a graticule and a Time/Div control position setting. 100% accuracy is required.

Lesson Topic 22.4 Oscillator Operation

TO 44.0 When the student completes this course, he will be able to TROUBLESHOOT an oscillator circuit, given a training device, required test equipment, technical manuals, schematics, and a practice board. Fault diagnosis to be 100% correct and any repair work completed on a practice board to pass a Learning Center Instructor's visual and physical check.

54

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 22.4.44.7 IDENTIFY the schematic diagrams of three basic (Armstrong, Colpitts, and Clapp) oscillators, by selecting the correct name for each schematic from a set of four schematic drawings and a list of names. 100% accuracy is required.

EO 22.4.44.7.1 IDENTIFY the purpose of the two series capacitors in the tank circuit of a Colpitts oscillator by selecting the correct statement, given a schematic and four statements about the tank circuit. 100% accuracy is required.

EO 22.4.44.7.2 IDENTIFY the sections of an Armstrong oscillator (tank, amplifier, or feedback), given a schematic of an Armstrong oscillator and labeled components in each of the sections by selecting the correct statement from a set of four statements. 100% accuracy is required.

EO 22.4.44.8 OBSERVE the change in frequency of a tank circuit when changing certain components given an oscilloscope a training device and a job program. 100% accuracy is required.

EO 22.4.44.9 IDENTIFY a commonly used voltage measuring device that should not be used to make voltage measurements on an oscillator circuit, given a list of test equipment. 100% accuracy is required.

EO 22.4.44.10 OBSERVE and RECORD the loading effects which occur when a VOM is connected to measure voltage in an oscillator circuit, given an oscilloscope, a VOM, a job program, and a device containing an oscillator circuit. All measurements to fall within tolerances stated in the experiment sheet.

EO 22.4.44.11 MEASURE and RECORD voltages in an oscillator circuit, given an EVM, oscillator training device, schematics, a job program and technical manual. Measurements to be within tolerances given in technical manual or progress check answer section.

		Classroom/ Learning Center	Practical Application/ Laboratory
EO	22.4.44.12 IDENTIFY a malfunctioning component in a prefaulted oscillator circuit, given the necessary tools, job program, a prefaulted training device, an oscilloscope and the appropriate technical manual or schematic. Fault diagnosis to be 100% correct.		

CURRICULUM OUTLINE OF INSTRUCTION

Contact Hours ____ Classroom/ Learning Center - Practical Application/ Laboratory

MODULE 23.0 MULTIVIBRATORS

Supported partially by this Module and partially by Modules 1 through 19 and 21

TO 45.0 When the student completes this course, he will be able to TROUBLESHOOT multivibrator (flip-flop, free-running, one-shot) circuits, given a prefaulted training device, appropriate schematics (or technical manual), test equipment, and necessary tools. Remove and replace similar components on a practice circuit board. Faulty component identification must be 100% accurate. Component replacement must pass Learning Center Instructor's inspection.

Lesson Topic 23.1 Bistable Multivibrator Operation (Flip-Flop)

TO 45.0 When the student completes this course, he will be able to TROUBLESHOOT multivibrator (flip-flop), free-running, one-shot) circuits, given a prefaulted training device, appropriate schematics (or technical manual), test equipment, and necessary tools. Remove and replace similar components on a practice circuit board. Faulty component identification must be 100% accurate. Component replacement must pass Learning Center Instructor's inspection.

EO 23.1.45.1 IDENTIFY the schematic diagram of a flip-flop (bistable) multivibrator by selecting the correct schematic diagram from a set of four choices. 100% accuracy is required.

EO 23.1.45.2 IDENTIFY the purpose of applying a triggering pulse to the toggle input of a bistable (flip-flop) multivibrator by selecting the correct statement from a set of four choices. 100% accuracy is required.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 23.1.45.3 CONSTRUCT a basic flip-flop (bistable) multivibrator, given a schematic diagram or a parts layout template for a flip-flop multivibrator and a supply of parts. The constructed circuit must be operational as specified in the job program.

EO 23.1.45.3.1 IDENTIFY the normal output waveform of a basic flip-flop multivibrator by selecting the illustration which resembles the normal output waveform of a flip-flop multivibrator for which the input signals and a flip-flop (with toggle) symbol are given. At least one input pulse will have no effect. 100% accuracy is required.

Lesson Topic 23.2 Astable Multivibrator Operation (Free-Running)

TO 45.0 When the student completes this course, he will be able to TROUBLESHOOT multivibrator (flip-flop, free-running, one-shot) circuits, given a prefaulted training device, appropriate schematics (or technical manual), test equipment, and necessary circuit board. Faulty component identification must be 100% accurate. Component replacement must pass Learning Center Instructor's inspection.

EO 23.2.45.4 IDENTIFY the schematic diagram of a free-running (astable) multivibrator by selecting the correct schematic from a set of four choices. 100% accuracy is required.

EO 23.2.45.5 IDENTIFY the correct output waveform of a basic free-running (astable) multivibrator by selecting the correct waveform description or illustration from a set of four choices. 100% accuracy is required.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 23.2.45.6 CONSTRUCT a basic free-running (astable) multivibrator, given a schematic diagram or a parts layout template for a free-running or astable multivibrator and a supply of parts. The constructed circuit must be operational as specified in the job program.

EO 23.2.45.6.1 OBSERVE, RECORD, and INTERPRET normal and abnormal output waveforms of a free-running (astable) multivibrator, given the necessary schematics, tools, job program, oscilloscope, and components or circuit boards. All measurements must fall within tolerances stated in the job program.

Lesson Topic 23.3 Monsotable Multivibrator Operation (one-Shot)

TO 45.0 When the student completes this course, he will be able to TROUBLESHOOT multivibrator (flip-flop, free-running, one-shot) circuits, given a prefaulted training device, appropriate schematics (or technical manual), test equipment, and necessary tools. Remove and replace similar components on a practice circuit board. Faulty component identification must be 100% accurace. Component replacement must pass Learning Center Instructor's inspection.

EO 23.3.45.7 IDENTIFY the schematic diagram of a one-shot (monostable) multivibrator by selecting the correct schematic from a set of four choices. 100% accuracy is required.

EO 23.3.45.8 IDENTIFY the correct output waveform of a basic one-shot (monostable) multivibrator by selecting the correct one-shot multivibrator output, for a given input, from a set of four choices. 100% accuracy is required.

EO 23.3.45.9 CONSTRUCT a basic one-shot (monostable) multivibrator, given a schematic diagram or a parts layout template and a supply of parts. The constructed circuit must be operational as specified in the job program.

		Classroom/ Learning Center	Practical Application/ Laboratory
EO	23.3.45.9.1 OBSERVE, RECORD, and INTERPRET normal and abnormal output waveforms of a one-shot (monostable) multivibrator, given the necessary schematics, tools, job program, an oscilloscope, and components or circuit boards. All measurements must fall within tolerances stated in the job program.		
EO	23.3.45.10 IDENTIFY a malfunctioning component in a prefaulted multivibrator (Bistable, Astable, Monostable) circuit, given the necessary tools, job program, a prefaulted training device, an oscilloscope, and the appropriate technical manual or schematic. Fault diagnosis to be 100% correct.		

Contact Hours _____ | Classroom/ Learning Center | Practical Application/ Laboratory

MODULE 24.0 WAVE SHAPING CIRCUITS

Supported partially by this Module and partially by Modules 1 through 19 and 21.

TO 46.0 When the student completes this course, he will be able to IDENTIFY wave shaping circuits and their effects on input waveforms by matching an output waveform to a wave shaping circuit and its input waveform given input and output waveform illustrations and wave shaping circuits schematic diagrams.

Lesson Topic 24.1 Clippers

TO 46.0 When the student completes this course, he will be able to IDENTIFY wave shaping circuits and their effects on input waveforms by matching an output waveform to a wave shaping circuit and its input waveform given input and output waveform illustrations and wave shaping circuits schematic diagrams.

EO 24.1.46.1 IDENTIFY the function of a clipper circuit by selecting the correct statement from a list of four statements. 100% accuracy is required.

EO 24.1.46.2 IDENTIFY the schematic diagrams for each of the five basic clipper circuits (series positive, series negative, parallel positive, parallel negative, and parallel positive and negative), given a set of five schematic diagrams, by selecting the schematic that matches the name given for each type of clipper circuit. 100% accuracy is required.

EO 24.1.46.2.1 IDENTIFY by selecting, the schematic diagrams of series/parallel clipper configurations given a set of schematic diagrams which includes one of each of the configurations. 100% accuracy is required.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 24.1.46.3 IDENTIFY by selecting, the output waveform for each of the following three clipper circuits (positive, negative, and parallel negative and positive), given input and output waveshapes and schematic diagrams. 100% accuracy is required.

EO 24.1.46.4 IDENTIFY by selecting, output waveforms showing bias effects on series and parallel clipper circuits given a choice of five schematic diagrams and their respective output waveforms. 100% accuracy is required.

EO 24.1.46.5 OBSERVE and INTERPRET clipper output waveforms (normal and abnormal) by varying the bias voltage on a series or parallel clipper circuit, given an oscilloscope, a job program, and a training device circuit. 100% accuracy is required.

EO 24.1.46.5.1 IDENTIFY the input section, conversion section, and the output section in each of the five basic clipper circuits (series positive, series negative, parallel positive and parallel positive and negative) by locating all of the components in each section, given a training device or circuit boards containing clipper circuits, a job program, and the applicable schematic diagrams or technical manuals. 100% accuracy is required.

Lesson Topic 24.2 Clampers

TO 46.0 When the student completes this course he will be able to IDENTIFY wave shaping circuits and their effects on input waveforms by matching an output waveform to a wave shaping circuit and its input waveform given input and output waveform illustrations and wave shaping circuit schematic diagrams.

EO 24.2.46.6 IDENTIFY the type of clamper output waveforms, given four/five schematic diagrams of clamper types and output waveforms. 100% accuracy is required.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 24.2.46.6.1 IDENTIFY by matching, the function of the resistor, the capacitor, the diode, and the source (battery) in a basic clamper circuit, given a schematic diagram, a list of functions, and a list of components. 100% accuracy is required.

EO 24.2.46.7 OBSERVE and INTERPRET clamper output waveform (normal and abnormal) given a training device/circuit, an oscilloscope, a job program, a variable bias supply, and a positive and/or negative clamper circuit. Interpret waveforms by answering applicable questions on the job program. 100% accuracy is required.

EO 24.2.46.7.1 LOCATE all of the components in each input section, output section, and conversion section of the two basic types of clamper circuits (positive and negative), given a training device or circuit boards containing clamper circuits, a job program, and the applicable schematic diagrams or technical manuals. 100% accuracy is required.

EO 24.2.46.7.2 IDENTIFY the type of clamper and the amount and polarity of bias, given a training device, a job program, an oscilloscope and the applicable schematic diagram. Either the oscilloscope waveform or schematic diagram, or both, may be used in analyzing for type and/or biasing. 100% accuracy is required.

Lesson Topic 24.3 Integrators/Differentiators

TO 46.0 When the student completes this course, he will be able to IDENTIFY wave shaping circuits and their effects on input waveforms by matching an output waveform to a wave shaping circuit and its input waveform given input and output waveform illustrations and wave shaping circuit schematic diagrams.

EO 24.3.46.8 IDENTIFY by selecting, the schematics for RL and RC integrator and differentiator circuits, given a set of schematic diagrams. 100% accuracy is required.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 24.3.46.9 ANALYZE the conversion action in RL and RC differentiator/integrator circuits, by matching given input and output waveforms to the correct schematic diagram, with 100% accuracy.

EO 24.3.46.10 DIFFERENTIATE "long" and "short" time constants of RL and RC circuits used as integrators and differentiators, given five time statements, an RC circuit and an RL circuit, and selecting the best statement of relative time constant length. 100% accuracy is required.

EO 24.3.46.11 OBSERVE, INTERPRET, and RECORD the effects of varying the time constant on an RC differentiator circuit, given a training device/circuit, and oscilloscope, and a job program. Recorded observations to fall within tolerances stated in the job program.

EO 24.3.46.11.1 LOCATE and IDENTIFY integrator and differentiator components installed in equipment, given a training device or circuit boards containing integrator/ differentiator circuits and circuit schematic diagrams or technical manuals and a job program. 100% accuracy is required.

CURRICULUM OUTLINE OF INSTRUCTION

Contact Hours _____ Classroom/ Learning Center | Practical Application/ Laboratory

MODULE 25.0 SPECIAL DEVICES

Supported partially by this Module and partially by Module 1 through 19 and 21.

TO 47.0 When the student completes this course, he will be able to TROUBLESHOOT faulty UJT/SCR circuits, given a training device, prefaulted UJT/SCR circuit cards, and proper tools. Repair to be done on a practice board with similar components. Repair board to pass Learning Center Instructor's visual and physical inspection for quality. Replace component to be tested for damage incurred during installation.

Lesson Topic 25.1 Silicon Control Rectifier Theory

TO 47.0 When the student completes this course, he will be able to TROUBLESHOOT faulty UJT/SCR circuits, given a training device, prefaulted UJT/SCR circuit cards, and proper tools. Repair to be done on a practice board with similar components. Repaired board to pass Learning Center Inspector's visual and physical inspection for quality. Replace component to be tested for damage incurred during installation.

EO 25.1.47.1 IDENTIFY by selecting, the names of the three leads of an SCR, given an unlabelled diagram of an SCR and a list of names. 100% accuracy is required.

EO 25.1.47.2 IDENTIFY the conditions necessary to make an SCR start conducting by selection the correct statement from a choice of four. 100% accuracy is required.

EO 25.1.47.3 IDENTIFY the conditions necessary to maintain an SCR in conduction by selecting the correct answer from a choice of four. 100% accoracy is required.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 25.1.47.4 IDENTIFY the conditions necessary to stop conduction of an SCR by selecting the correct answer from a choice of four. 100% accuracy is required.

EO 25.1.47.5 OBSERVE and RECORD waveforms from an SCR AC control circuit, given a training device or circuit and the proper tools, an oscilloscope, a job program, and schematic diagrams or technical manuals. Recorded data must be within limits shown in the job program.

EO 25.1.47.6 OBSERVE and RECORD waveforms from an SCR DC control circuit given a training device or circuit and the proper tools, an oscilloscope, a job program, and schematic diagram or technical manuals. Recorded data must be within limits shown on the job program.

Lesson Topic 25.2 Unijunction Transistor Theory

TO 47.0 When the student completes this course, he will be able to TROUBLESHOOT faulty UJT/SCR circuits, given a training device, prefaulted UJT/SCR circuit cards, and proper tools. Repair to be done on a practice board with similar components. Repair board to pass Learning Center Instructor's visual and physical inspection for quality. Replace component to be tested for damage incurred during installation.

EO 25.2.47.7 IDENTIFY by matching, the names of the three leads of a UJT given an unlabelled diagram of a UJT and a list of names. 100% accuracy is required.

EO 25.2.47.8 IDENTIFY the conditions necessary to make a UJT conduct by selecting the correct statement of conditions from a choice of four. 100% accuracy is required.

EO 25.2.47.9 DEFINE the term "voltage gradient" as it applies to a UJT by selecting the correct answer from a choice of four. 100% accuracy is required.

	Classroom/ Learning Center	Practical Application/ Laboratory

EO 25.2.47.10 IDENTIFY the conditions necessary to maintain conduction of a UJT by selecting the correct answer from a choice of four. 100% accuracy is required.

EO 25.2.47.11 IDENTIFY the conditions necessary to stop conduction of a UJT by selecting the correct answer from a choice of four. 100% accuracy is required.

EO 25.2.47.12 OBSERVE and RECORD normal waveforms from a UJT sawtooth generator circuit given a training device, a job program, proper tools, an oscilloscope, a signal generator, and applicable schematic diagrams or technical manuals. Recorded data must be within limits stated in job program.

EO 25.2.47.13 OBSERVE and RECORD waveforms from a UJT multivibrator circuit given a training device, proper tools, an oscilloscope, a signal generator, a job program, and schematic diagrams or technical manuals. Recorded data must be within limits stated on the job program.

EO 25.2.47.14 OBSERVE and RECORD normal waveforms from a UJT trigger circuit given an applicable training device or circuit and the proper tools, an oscilloscope, a signal generator, a job program, and schematic diagrams or technical manuals. 100% accuracy is required.

EO 25.2.47.15 LOCATE a faulty component in a SCR control circuit/UJT ramp generator circuit by discriminating between normal and abnormal waveforms from a prefaulted training device or circuit, and using the proper tools, an oscilloscope, a signal generator and given a job program and schematics or technical manuals. 100% accuracy is required.

ANNEX

TRAINING EQUIPMENT LIST

NOMENCLATURE	Type Designator or Device Number	National Stock Number	Per Site Quantity	Per Item Cost
PLASTIC CHASSIS BOX	0001	N61339-78-C-0117	520	
POWER CORD/PLUG	002	N61339-78-C-0117	520	
CANNON PLUG	0005/0006	N61339-78-C-0117	520	
POWER RECEPTACAL		PT#5385 SAN001	520	
12 IN/3 CONDUCTOR CABLE				
25 IN 25 AWG WIRE	25AWG			
SOLDERING KIT				57.46
PRACTICE CARD				
6B25 PRINTED CIRCUIT POWER SUPPLY KIT		N61339-78-C-0165		4.95
6B25 RADIO RECEIVER	6B25	6910-LL-L00-3686	152	110.00
SIGNAL GENERATOR	AN/URM-25D	6625-00-649-5193	196	
FIXED ATTENUATOR	CN-224/ERM-25D			
SWEEP GENERATOR	WAVETEK 186	PT#206910	91	790.00
HEADSET, TEXEX	610-1		300	
PREFAULT CARD		6910-C00-3686		194.68
PARTS IDENTIFICATION BOARD	NETSCPAC	11-7400111-1M		
IX PROBE,TEKTRONIX	P6028	6625-907-8358	80	24.90
IX PROBE, TEXTRONIX	P6006	6625-738-6751	80	47.50
OSCILLOSCOPE	NIDA 207/or	6910-LL-L00-4519	100	900.00
	6B28	6910-LL-L00-4519	30	900.00
MULTIMETER	SIMPSON 260-5P	6625-00-643-1693	560	138.00
ASST JUMPER WIRES				Locally Procured
DOUBLE BANANA PLUG CABLE		GS-00S-06673		
NIDA CONNECTING CABLES			100	2.00
BNC TEE CONNECTOR		5935-00-926-7523	100	1.96
GROUNDING STRAPS				

NOMENCLATURE	Type Designator or Device Number	National Stock Number	Per Site Quantity	Per Item Cost
VACUUM TUBE	6C4	5960-00-557-6780	50	.76 ea
VACUUM TUBE	6AU6	5960-00-179-3710	50	.93 ea
TUBE TESTER	TV-7D/U or TV-10D/U	6625-00-648-8346	20	
ASST VACUUM TUBES	Assorted	Locally procured		
MULTIGENERATOR TEST SIGNAL BOX	124 Exact			595.00
ELECTRONIC VOLTMETER	AN/USM-116	6625-00-017-8981	37	
RCA TRAINER	6F16			
6F16 SUPPLEMENTAL PARTS BOX				
6F16 TEMPLATE SET A-M, 1 & 2				
POWER SUPPLY	NIDA 201	6910-LL-L00-4520	53	
LOAD BOX	NIDA 201L		72	
AMPLIFIER (S/S)	NIDA 202	6910-LL-100-4522	98	
AUDIO OSCILLATOR	NIDA 203	6910-LL-L00-4523	63	
FUNCTION GENERATOR	NIDA 204	6910-LL-L00-4524	44	
AMPLIFIER (VAC TUBE)	NIDA 206	6910-LL-L00-4525		
SET PRINTED CIRCUIT CARDS	PC-201-1 through PC-206-4			990.00
VOLTOHMIST	WV-77E		465	
SIGNAL GENERATOR	E1C0377			170.00
PROJECTOR BESSELER, STATIC MOTION		6730-LL-L00-4173	108	

TRAINING MATERIAL LIST

MILITARY PUBLICATIONS

NUMBERS (MILPUBS)	COMPLETE TITLE	PER SITE QUANTITY
NAVEDTRA 34258 15-19	BASIC TROUBLESHOOTING SKILLS	40
NAVEDTRA 34258-20/20T	SOLID STATE POWER SUPPLIED/ELECTRON TUBE POWER SUPPLIES	5
NAVEDTRA 34258-21/21T	BASIC TRANSISTOR THEORY/MULTI ELEMENT VACUUM TUBES	5
NAVEDTRA 34258-22	OSCILLATORS	5
NAVEDTRA 34258-23	MULTIVIBRATORS	5
NAVEDTRA 34258-24	WAVE SHAPING CIRCUITS	5
NAVEDTRA 34258-25	SPECIAL DEVICES	5
NAVTRADEV P-4047	TECHNICAL MANUAL 6B25	40
TM-11-6625-274-12	TECHNICAL MANUAL-TV-7D/U TUBE TESTER	5
NAVSHIPS 92134A	TECHNICAL MANUAL - SIGNAL GENERATOR AN/URM-25D	40
MIL-STD-454e	MILITARY STANDARD, STANDARD GENERAL REQUIREMENTS FOR ELECTRONIC EQUIPMENT	40
MIL-M-15071G	MILITARY SPECIFICATIONS, MANUALS TECHNICAL, EQUIPMENT AND SYSTEM CONTENT	5
NAVSHIPS 94500A	TECHNICAL MANUAL GUIDE	5
MIL-M-38784A	MILITARY SPECIFICATION, MANUALS TECHNICAL, GENERAL STYLE AND FORMAT REQUIREMENTS	5
MIL-M-63000A)SM)	MILITARY SPECIFICATION, MANUALS TECHNICAL GENERAL PREPARATION INSTRUCTIONS FOR MANUSCRIPTS AND ILLUSTRATIONS	5
NAVSHIPS 0967 000 000	ELECTRICAL INSTALLATION AND MAINTENANCE BOOK	3
NAVPERS 93400A	FUNDAMENTALS OF ELECTRONICS	40
NAVPERS 10087C	BASIC ELECTRONICS, Vol. 1 and 2	40

AUTHOR (Commercial or (Civilian Pubs)	COMPLETE TITLE, PUBLISHING COMPANY, EDITION, DATE	QUANTITY
MARKUS, JOHN	ELECTRONICS AND NUCLEONICS DICTIONARY MCGRAW-HILL 1966	3
EXACT ELECTRIC CO.	TECHNICAL MANUAL-EXACT 124 MULTIGENERATOR 1972	5
WAVETEK CORP	TECHNICAL MANUAL-WAVETEK 186 SWEEP GENERATOR	5
GENERAL ELECTRIC CO.	G.E. SCR MANUAL (1973)	3

NOMENCLATURE	Type Designator or Device Number	National Stock Number	Per Site Quantity	Per Item Cost
VACUUM TUBE	6C4	5960-00-557-6780	50	.76 ea
VACUUM TUBE	6AU6	5960-00-179-3710	50	.93 ea
TUBE TESTER	TV-7D/U or TV-10D/U	6625-00-648-8346	20	
ASST VACUUM TUBES	Assorted	Locally procured		
MULTIGENERATOR TEST SIGNAL BOX	124 Exact			595.00
ELECTRONIC VOLTMETER	AN/USM-116	6625-00-017-8981	37	
RCA TRAINER	6F16			
6F16 SUPPLEMENTAL PARTS BOX				
6F16 TEMPLATE SET A-M, 1 & 2				
POWER SUPPLY	NIDA 201	6910-LL-L00-4520	53	
LOAD BOX	NIDA 201L		72	
AMPLIFIER (S/S)	NIDA 202	6910-LL-100-4522	98	
AUDIO OSCILLATOR	NIDA 203	6910-LL-L00-4523	63	
FUNCTION GENERATOR	NIDA 204	6910-LL-L00-4524	44	
AMPLIFIER (VAC TUBE)	NIDA 206	6910-LL-L00-4525		
SET PRINTED CIRCUIT CARDS	PC-201-1 through PC-206-4			990.00
VOLTOHMIST	WV-77E		465	
SIGNAL GENERATOR	E1C0377			170.00
PROJECTOR BESSELER, STATIC MOTION		6730-LL-L00-4173	108	

TRAINING MATERIAL LIST

MILITARY PUBLICATIONS

NUMBERS (MILPUBS)	COMPLETE TITLE	PER SITE QUANTITY
NAVEDTRA 34258 15-19	BASIC TROUBLESHOOTING SKILLS	40
NAVEDTRA 34258-20/20T	SOLID STATE POWER SUPPLIED/ELECTRON TUBE POWER SUPPLIES	5
NAVEDTRA 34258-21/21T	BASIC TRANSISTOR THEORY/MULTI ELEMENT VACUUM TUBES	5
NAVEDTRA 34258-22	OSCILLATORS	5
NAVEDTRA 34258-23	MULTIVIBRATORS	5
NAVEDTRA 34258-24	WAVE SHAPING CIRCUITS	5
NAVEDTRA 34258-25	SPECIAL DEVICES	5
NAVTRADEV P-4047	TECHNICAL MANUAL 6B25	40
TM-11-6625-274-12	TECHNICAL MANUAL-TV-7D/U TUBE TESTER	5
NAVSHIPS 92134A	TECHNICAL MANUAL - SIGNAL GENERATOR AN/URM-25D	40
MIL-STD-454e	MILITARY STANDARD, STANDARD GENERAL REQUIREMENTS FOR ELECTRONIC EQUIPMENT	40
MIL-M-15071G	MILITARY SPECIFICATIONS, MANUALS TECHNICAL, EQUIPMENT AND SYSTEM CONTENT	5
NAVSHIPS 94500A	TECHNICAL MANUAL GUIDE	5
MIL-M-38784A	MILITARY SPECIFICATION, MANUALS TECHNICAL, GENERAL STYLE AND FORMAT REQUIREMENTS	5
MIL-M-63000A)SM)	MILITARY SPECIFICATION, MANUALS TECHNICAL GENERAL PREPARATION INSTRUCTIONS FOR MANUSCRIPTS AND ILLUSTRATIONS	5
NAVSHIPS 0967 000 000	ELECTRICAL INSTALLATION AND MAINTENANCE BOOK	3
NAVPERS 93400A	FUNDAMENTALS OF ELECTRONICS	40
NAVPERS 10087C	BASIC ELECTRONICS, Vol. 1 and 2	40

AUTHOR (Commercial or (Civilian Pubs)	COMPLETE TITLE, PUBLISHING COMPANY, EDITION, DATE	QUANTITY
MARKUS, JOHN	ELECTRONICS AND NUCLEONICS DICTIONARY MCGRAW-HILL 1966	3
EXACT ELECTRIC CO.	TECHNICAL MANUAL-EXACT 124 MULTIGENERATOR 1972	5
WAVETEK CORP	TECHNICAL MANUAL-WAVETEK 186 SWEEP GENERATOR	5
GENERAL ELECTRIC CO.	G.E. SCR MANUAL (1973)	3

RCA CORPORATION	RCA SOLID STATE '74 DATA BOOK SERIES SSD 200B (1973)	5
CSA 299/ ANSI Y32.2-1970/ IEEE No. 315	GRAPHIC SYMBOLS FOR ELECTRICAL AND ELECTRONICS DIAGRAMS, THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERING, INC./AMERICAN NATIONAL STANDARDS INSTITUTE, INC., 17 November 1970	2
RCA CORP	VOLTOHMYST TYPE WV-77E, 3-64	5
SIMPSON ELECTRIC CO.	VOLT-OHM-MILLIAMMETER 260, Series 5P, 1967	5
NIDA CORP	TECHNICAL MANUAL - NIDA 201	40
NIDA CORP	TECHNICAL MANUAL - NIDA 201L	40
NIDA CORP	TECHNICAL MANUAL - NIDA 202	40
NIDA CORP	TECHNICAL MANUAL - NIDA 203	40
NIDA CORP	TECHNICAL MANUAL - NIDA 204	40
NIDA CORP	TECHNICAL MANUAL - NIDA 206	40
SYMETRICS CORP.	TECHNICAL MANUAL - OSCILLOSCOPE 6B28 OR	40
NIDA CORP OR	TECHNICAL MANUAL - OSCILLOSCOPE NIDA 207	40